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Persuasive design principles: means to improve the use of information organisation and search features in Web site information architecture?

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Abstract
Many information retrieval systems contain advanced information organisation and search features that are seldom utilized fully by end-users. Users are quickly browsers with a poor understanding of information needs and how to develop effective search strategies. Searching aids are needed to assist the user through the search process. The paper presents the concept of persuasive technology and investigates persuasive principles as a means to guide users and improve their understanding and use of information organization and search features. The assumption is that persuasive principles can be used in information retrieval to enable particular searching behaviors by making them simpler, easier, and thus more attractive to the user. The analysis is based on a case study approach. Persuasive principles are analysed and compared to features at the public portal Startvækst (StartGrowth) that provide information and services for entrepreneurs and growth businesses. The analysis shows that persuasive principles of *tailoring*, *reduction*, and *tunnelling* may ease complex query formulation through simplifying the user-system interaction. The principles *suggestion*, *surveillance*, and *monitoring* may be used to inform and encourage the user to take advantage of system features. The principles are not revolutionary, but they provide a useful tool for analysis and generation of ideas how to implement supportive features in Web site information architecture. The analysis exposes several challenges to investigate in future research: Kairos, the opportune moments to present persuasive principles; zones of intervention, when do the user need support in the retrieval process; what data about user behaviour is useful for surveillance and monitoring; usability, ethics and user satisfaction, what is the appropriate mode for surveillance, control, reduction and persuasion

Keywords: digital libraries; human computer interaction; information architecture; knowledge structures

1. Introduction

Although many systems for information retrieval (IR) contain advanced information organisation and search features, research findings on end-user searching in online retrieval systems show that users seldom use these features or have difficulty applying them in their searches (Jansen, 2005; Markey, 2007a). End-users enter few and short search statements and browse few pages of ranked results. Users are not taking advantage of available search features: commands, Boolean logic, metadata, and controlled vocabularies.

Recent studies of young people's Web information behaviour confirm earlier findings, and characterize the Google generation as quickly browsers with very short session time (Rowlands et al., 2008). Young users view more than they read, and they often have a poor understanding of their information need and how to

develop it to effective search strategies. Like previous online users, the Web generation has great difficulties navigating and profiting from the virtual information environment. When they are asked to describe the problems they have in navigating and using Web site organisation systems, they most frequently mention issues related to categorization and labelling (Jacob & Loehrlein, 2009). It is a well-known problem for users of IR systems to capture the vocabulary and organisation of the system.

Getting better information skills and understanding of the system features is important, and search aids are needed to assist the user through the search process (Rowlands et al., 2008). Retrieval systems should intervene with complex search features that are likely to solve user problems, and monitor users to determine whether these complex features help them achieve their goals (Markey, 2007b). IR systems should guide and motivate, focussing user's attention on available information organisation systems and search features and providing support how to use the features and generate better searches.

In this paper, we present the concept of persuasive technology and investigate persuasive principles as a means to guide users and improve their understanding and use of information organization and search features. Persuasive design principles refer to the general principle of designing interfaces and interactive features to encourage people to behave in certain ways (Fogg, 2003). Persuasion is about changing attitude and motivating behavior. It may seem a marketing approach, but can be used in more neutral ways in, e.g. to help searchers perform difficult tasks such as creating a more expressive query or spending more time investigating the information organization (Ruthven, 2008). The assumption is that persuasive principles can be used in information retrieval to enable particular search behaviors by making them simpler and easier and thus more attractive to the user. The aim of our analysis is to gain insight into persuasive design principles and examine how they may improve user-system interaction. We specifically address whether persuasive principles may be used to improve users' ability to exploit Web site information architecture.

The paper is organized as follows: Section 2 describes the theoretical framework and research design used to examine persuasive principles. The section includes a presentation of the content Web site Startvækst that forms the case study. Section 3 presents and discusses the results of the analysis, and Section 4 concludes the paper and presents suggestions for further research.

2. Research design

The analysis is based on a case study approach. Persuasive principles are analysed and compared to features at the public portal Startvækst (StartGrowth) that provides information and services for entrepreneurs and growth businesses. The analysis takes the retrieval process and problems in formulation and modification of search queries as starting point, and discusses how persuasive principles may guide the user to utilize information organisation and search features efficiently and develop suitable searching and browsing strategies.

2.1. Theoretical and analytical framework

Wilson (1999) developed the nested model of information seeking and searching in which he divides the field of information behaviour investigation into three levels:

a) Information behaviour, the general field of investigation:
b) Information seeking behaviour as a sub-set concerned with the variety of methods people employ to discover and gain access to information resources, and
c) Information search behaviour, concerned with the interactions between information user (with or without an intermediary) and computer-based information systems.

In this analysis we focus on information search behaviour and the problems that users encounter when they interact with computerised information retrieval systems. The study is furthermore limited to information

searching in content Web sites that create and distribute original content, specifically to the Website information organisation and search features.

We use Morville & Rosenfeld's (2007) definition and framework of information architecture (IA) as basis for the analysis, because this model has been specifically designed to Web systems such as Web sites and intranets (Jacob & Loehrlein, 2009). We concentrate the analysis on the four IA components: organisation system, label system, navigation system, and search system, and analyse how persuasive strategies may improve the users' ability in operating these organisation structures and features in the searching process.

The *organisation system* is composed of organization schemes, which define and group Web site content items, and organisation structures that define the types of relationships between content items and groups. The *label system* is the set of expressions that represent and name groups or chunks of content in the Website. Labels may be textual or iconic, and may appear as *headings* describing content items, *navigation system choices* representing options in the navigation system, *index terms* (metadata, tags, keywords, subject headings) representing content for searching by the search interface or browsing the organisation system, and *contextual links*, hyperlinks to content items, other Web pages, or to other location on the same page. The *navigation system* is composed of several basic elements. The global, local and contextual navigation systems are integrated within the Web pages themselves and infused with the content of the site. These subsystems provide context and flexibility, helping users understand where they are and where they can go. Second, the navigation system consists of supplemental systems such as sitemaps, indexes and guides that exist outside the content bearing pages. A third type of navigation system is the more advanced systems such as social navigation by folksonomies and recommendation systems. Each type of supplemental navigation system serves a unique purpose and is designed to provide different ways of assessing the Web site content. We consider these three IA components as the IR system's information organisation structures. The *search system* is composed of the search interface and search engine. We focus the analysis on the search interface, and specifically on the search features that interactively support the user in formulating and modifying the search, such as the search box, drop-down lists and search filters.

We work from Ingwersen & Järvelin's (2005) model of the search process that describes information retrieval as an iterative process consisting of six main tasks, which are strongly connected and in practice are carried out interactively:

- perception of a work task or problem situation
- analysing and conceptualising the information need
- locating and choosing the appropriate sources
- choosing access terms, formulating queries or browsing strategies
- evaluating the search result and feedback from the retrieval system
- modifying the information need and/or the access terms according to experience, learning and feedback

Information retrieval is based on a match between terms specified by the users to represent the information need and terms appearing in the database to represent the information objects. The outcome of the retrieval depends to a large extend on the user's choice of search terms, and the way they are applied to the database. Search success depends on the user's ability to identify and articulate the facets of the search topic and express the facets by an appropriate set of search terms (Kekäläinen & Järvelin, 2000; Vakkari et al. (2003). This applies to query-based searching by use of the search system and to non query-based searching by use of the organisation and navigation system where labels and hyperlinks and the inherent navigation choices, even if indirectly, act as search terms.

The information retrieval process is complex and demands domain knowledge as well as knowledge about information retrieval. The user must know about the task domain, subject area, information task, IR system, and how to interact with the information architecture, choose access terms, apply search features and im-

plement search and navigation strategies. The outcome of the retrieval depends on the user's ability to combine knowledge about the domain and problem situation, system features, and search strategies.

In the analysis we focus on the four IA components and study how the information structures and search features are presented to the user when he is formulating and modifying the search, searching or navigating the Website.

2.2. Persuasive principles

The study of computers as persuasive technologies is relatively new, and refers to the general principle of designing interfaces and interactive features to encourage people to behave in certain ways. Fogg (2003) coined the field with the term 'captology', and defined the functional triad, which is a framework for thinking about the roles that computing products play. The framework is used to analyse and define the role of technology: as tool, medium or social actor. The persuasive tool makes target behaviour easier to do, leads people through processes, or performs calculations or measurements that motivate. The persuasive medium provides experiences that stimulate changed behaviour, e.g. help people rehearse behaviour or explore cause-effect relationships. The computer as social actor persuades by rewarding people with positive feedback or providing social support.

We focus the analysis on the computer as tool that supports and increases the user's capability in IR. Some of the prevalent persuasive principles relate to an understanding of the computer as a tool. We use these principles or techniques to guide the analysis:

1. Reduction – making actions or information a simple as possible
2. Tunnelling – leading users through a predetermined sequence of actions or events
3. Tailoring – customizing actions or information to user needs and characteristics
4. Suggestions - suggesting a certain action or behaviour at the most opportune moment
5. Self-monitoring – monitoring behaviour in order to modify actions or behaviour to achieve a predetermined goal or outcome
6. Surveillance – monitoring the behaviour of another to modify behaviour in a specific way
7. Conditioning – shaping behaviour by rewarding a certain behaviour

The fundamental persuasive idea is rhetorical. Based on an understanding of the context (situatio), content (res), users (scena), system (verba), and database owner (orator), the designer builds in features that guide the user and motivate him to a better use of the system facilities.

We use the persuasive principles as framework to analyse how to build in guidance and motivation into the information architecture; how to change the user's behaviour to a better and more conscious usage of the IA components. Many Web sites and IR systems have already included features that may be considered as persuasive. The principles are not unknown or revolutionary. The purpose of the present study is to examine if and how persuasive principles can guide the design process and improve users' behaviour to a better and more conscious usage of the IA components. By analysing systematically the persuasive design principles, we investigate whether and how they are relevant tools to inform design.

2.3. Case study

The content Web site Startvækst (http://www.startvaekst.dk/) is operated by the Danish Enterprise and Construction Authority in cooperation with a number of public and private partners. The regional Business Link centres, which are operated in interaction among local authorities, regional growth fora and the Danish Enterprise and Construction Authority, are integrated into the portal, each with their own regional homepage.

Startvækst offers information and a number of tools for use by the entrepreneur and the business owner. There are articles about enterprise start-up, financing, internationalisation, franchise, and templates for use in preparing budgets and contracts and in designing business plans. There are news and information about

events with a calendar to be completed by Startvækst users. The regional Business Links provide guidance targeted at entrepreneurs and businesses having ambitious plans such as cultivating new markets, inventing new products or employing more people. The Business Links provide contact to private advisers such as banks, accountants, and lawyers and to a large number of public actors. In the service Ask the Expert, experts give free answers to questions about how to set up in business, accounting, finance, insurance and many other subjects. In the Adviser Database entrepreneurs and small and medium-sized businesses can find private advisers who offer free initial advice. On My Page the user has access to own settings and tools saved on Startvækst. Startvækst's information architecture will be described in section 3 Analysis.

Figure 1: *The content Web site Startvækst.*

3. Analysis

The analysis is divided into two subsections. First we analyse the Web site information organisation that is composed by the organisation system, label system, and navigation system, and secondly we examine the search system, specifically the search features to formulate and modify the search query. We present the IA components and discuss how the persuasive principles can be used to improve presentation of IA components and motivate to better search behaviour.

3.1. Information organisation

The information organisation at Startvækst is composed of a set of individual IA organisation systems combined by hyperlinks and rules in the navigation system. The central organisation system consists of four main subject categories, each with a hierarchical structure. Together they form a taxonomic structure and provide access to the principal Web site content. They appear on all pages as part of the navigation system. One main category represents Tools, and three categories represent user groups and divide the content depending on the user's situation or role:

- Tools – access to 50 tools such as templates for legal documents and business documents, tools for SWOT analysis;
- Entrepreneur – information for the entrepreneur considering starting up a business;
- Business – information for the business owner who wants good advice to meet the daily challenges of his or her business ;
- Growth business – information for the business owner who needs assistance and inspiration to make his or her business grow and develop.

A part from the main categories, the organisation system consists of seven separate categories that are used independently in the navigation system. These categories appear in the navigation system at selected Web pages and as cross references. Two of the categories are news information: News and Campaigns. Four categories refer to facilities that provide computer-mediated or personal assistance and support: Guides, Advisers, Ask an Expert, and Business Links. One category guides the user to Other Websites. Also the main category Tools appears as independent cross reference, referencing to tools relevant in a specific context.

Figure 1 shows the content Website Startvækst. The main categories Entrepreneurs (Iværksætter), Business (Virksomhed), Growth Business (Virksomhed i vækst) and Tools (Værktøjer) compose the global navigation system that appears in the bottom line of all subpages. At the top page the global navigation system is furthermore presented at the top of the page. All subpages offer two local navigation systems. At the left side appears the taxonomy, the hierarchical organisation structure for the main four categories, and at the right side appears a selected set of the individual categories, e.g. Business Links, News, Advisers, Other Websites. Figure 1 shows the local navigation system at left side, and two individual categories at the right side: Tools (Værktøjer) and News (Nyhedsbrev). Article headings are used as contextual links. There is a sitemap for the Website, and under the main categories Entrepreneurs, Business, Growth Business the navigation system offers two recommendation systems: Users Recommend and Mostly Read Articles. The recommendations appear in Figure 1 as respectively Users recommend (Brugerne anbefaler) and Mostly Read Articles (Mest Læste). The users are invited to tag the articles and comment them. Commenting demands that the user signs in.

In Web site information architecture the organisation system's categories and contextual links act as descriptors and access terms to the Web site content. Because the descriptors, thus search terms, are integrated in the navigation system and presented explicitly, they are very visible for the user compared to query based search modes. However, knowing about the busy browsers that view more than they read, we still need to consider the presentation of access points in navigation systems.

The persuasive principle *Tailoring*, designing to the use context, individual's needs, interests, personality, or other factors relevant to the individual is a commonly used principle in IA design, inherent in most domain- and user-oriented models for the design of controlled vocabularies and information structures (Mai, 2008). The principle is also present in Startvækst in the choice of the main organisation according to user role and situation. Similarly cross references are tailored depending on the subcategory clicked in the taxonomy. When the user chooses the subcategory Growth Business a selected set of subcategories appear related to growth, and when the user chooses the category Entrepreneur another set of categories relevant to entrepreneurship is shown. Tailored cross references are an efficient means to guide and motivate the user.

Cross references can be tailored, but at the same time they are also examples of the persuasive principle *Suggestions.* When we refer the user to related categories, we suggest new access points and search terms. Suggestions can be implemented in several ways. In Startvækst relationships are primarily used to relate categories from the main organisation system to independent categories. It may be useful also to relate categories across hierarchies in the main organisation system, e.g. refer from the category Administration in the entrepreneur section that provide basic management information to the category Management that provide access to advanced management information in the Growth Business section. Presentation of categories as part of the campaign structure is another way to implement Suggestions, e.g. to promote the category Taxes at the entrance Webpage in the period when business is expected to send tax returns to the authorities.

Tunnelling is the strategy where the user is guided through a tunnel of procedures and best practices for a certain activity. The hierarchical structure in itself may be considered a kind of tunnel as the user is guided from general to more specific access points. However, the guiding may be extended so that the user is not only guided to more specific or general categories, but to selected categories that are essential in order to carry out a certain activity. To give an example: in the main category for Business appears the subcategory Sale that contains information about sales drive, sales speech, sales literature, etc. This category could be developed by use of the principle of tunnelling by integrating a step by step guide (tunnel) that go through the different steps in sales, and for each step (preparation, marketing, negotiation, contract) present content, other categories, and other Web pages that are specifically relevant for that part of the sale process. Tunnelling leads the user through relevant steps for activity and presents relevant information at each step. Tunnelling is not implemented at Startvækst.

Another way to guide the user and reduce complexity is the strategy of *Reduction.* Information retrieval is a complex process that demands domain knowledge as well as IR knowledge how to formulate queries and select access points. A well-known way to build in reduction of complexity in the querying process is to clearly show specific aspects of a topic by using sub-divided categories such as ‘Law – customer data’ and ‘Law – advertising’. Another and more advanced tool is to integrate the taxonomy and the search system such as it is done in some taxonomy software designed to assist full text searching. In taxonomies for full-text searching synonym rings or predefined search queries are added to the categories. Clicking a category a search query is put forward to the search engine, and a set of documents are retrieved and presented to the user. By integrating pre-defined search queries into the taxonomy it is possible to automate and carry out complex searches for the user and hereby reduce complexity in information retrieval. Critical issues are identification of zones of intervention where the user needs support in information retrieval, and development of appropriate search strategies. The reduction principle is not present in Startvækst.

The principle of S*urveillance* and *Monitoring* means to collect information about user behaviour and monitor the behaviour in order to motivate or modify behaviour; it is included in Starvækst in several forms. The feature Users Recommend collects user ratings and uses the rating to promote Web content. The feature Mostly Read Articles is based on user clicks, and promote frequently read articles. These are good examples of surveillance and monitoring, and show how user behaviour and experiences may be used to guide to relevant information. The critical issue is to decide what user behaviour data are useful for developing surveillance and monitoring features. Another important issue related to surveillance and monitoring is ethics and privacy, what user data can we capture and how can we use and show them.

Social tagging is another feature based on surveillance and monitoring that can be used to improve the information organisation by providing new access points to Web site content and categories. Social tagging is included in Startvækst, but no users make use of the feature. Social tagging systems typically face barriers such as getting people interested, making sense of the data people create, lack of time (Smith, 2008). Social software has inherent problems of motivation, and persuasion is an essential issue.

Capturing information about navigation behaviour is another example of surveillance and monitoring that can be used to establish relationships and cross reference between categories based on user behaviour. The

captured data may be used either to refer categories to users with similar behaviour or to revise the organisation structure and tailor it according to user behaviour. Self-monitoring can remind the user of ineffective or successful behaviour, and inspire to change or allow the user to start from previous (successful) search strategies.

Conditioning, shaping behaviour by rewarding certain behaviour, is not used in Startvækst. But the principle may motivate in certain situations , e.g. in training situations or in IR systems that require fees, by rewarding good behaviour by free search time, extra downloads, etc.

3.2. Search system

The Startvækst search system is a full-text search engine with a simple search box, and the possibility to narrow the search by region. When a search has been carried out, the search result may be narrowed and filtered by region or to two campaigns Web sites Early Warning (for companies in crisis) and Week 47 (campaign week 47 with focus on power and innovation). The result list displays the title, highlights search terms surrounded by two lines of text, and shows the location of the content in the taxonomy. The ranking of results is not explained to the user.

The search system and features in Startvækst are simple, and several persuasive design strategies could be used to improve user interaction. The Web site is a domain-specific with a clear target group. It offers a tailored organisation system, and it seems obvious to integrate the tailored categories in the search system, and allow the user to specify search results to tailored categories.

The clear scope provides good possibilities to integrate *suggestions* in the search interface, e.g. in form of synonym rings for essential concepts expanding full text search, either automatically or interactively. The Web site is small, but it may still be relevant to implement suggestions in form of pop-up windows that guide the user who gets zero or very large search result sets that need modification. As regards suggestions in form of pop-up windows, the principle of *Kairos*, the opportune moment to present your message, is very important in order to motivate the user instead of annoying the user with unnecessary, redundant information.

By the principle *Suggestions* the user is in charge and carries out the search interactively. The strategy of *Reduction* is a means to ease user action by automation. Useful ways of taking the burden the user are 1) predefined query formulations integrated in the organisation system, 2) use of synonym rings that translate or expand search terms automatically, and 3) the use of tunnelling (as described in section 3.1.).

The strategy of *tunnelling* may be overkill in relation to query formulation in Startvækst, but guiding users through the sub processes of information retrieval may be useful in larger IR systems, especially if the guiding is related to specific types of search tasks, for example broad, recall oriented searches or searches related to a certain activity, e.g. sales activities or managing insolvency.

The strategy of *surveillance* and *monitoring* may improve user interaction, e.g. by ranking search results according to previous user behaviour and previous user recommendations. Another option is to present earlier successful searches at the time of log-in and in this way allow the user to profit from earlier experiences.

4. Conclusion

The purpose of the analysis was to examine how persuasive design principles can be used to improve user-system interaction, specifically to address whether persuasive principles can be used to improve users' ability to understand and exploit information structures and search features in information retrieval. We know from

user studies that end-users seldom utilize available features optimally. They need support in the retrieval process, when searching by queries or navigating the information structure.

The analysis shows that the persuasive principles of *tailoring, reduction,* and *tunnelling* may ease complex query formulation through simplifying the user-system interaction. Principles of *suggestion, surveillance* and *monitoring* may be used to inform and encourage the user to take advance of system features.

The analysis did not provide any extraordinary design ideas, but identified potential features and location where to build in persuasion in the information architecture. Many of the persuasive features discussed are well-known and commonly used. The principles are not revolutionary, but they provide a useful tool and framework for analysis and generation of ideas how to implement supportive features in Web site information architecture. It seems worthwhile to pursue the persuasive line of thought when implementing and presenting information organisation structures and search features to users.

The analysis exposed several challenges and issues that should be considered and investigated in future research:

- Identify and examine Kairos, the opportune moments to present suggestions, guides, or reduce complexity
- Identify and examine search problems, the zones of intervention where the user needs support in information retrieval
- Identify and examine user behaviour, what behaviour is useful as basis for surveillance and persuasive features
- Examine usability, user satisfaction and ethics. Studies show that users prefer interaction to automation, crucial to study the boundary for surveillance, control, reduction and persuasion

Persuasive design principles may improve end-users' exploitation of information organisation and search features. The challenge is to find the appropriate features and modes of interaction and automation.

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